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FACULTY WORKING
PAPER NO. 937

Trends in Rail Transport in Four African Countries Zimbabwe, Zambia, Tanzania, Sudan

John F. Due

College of Commerce and Business Administration
Bureau of Economic and Business Research
University of Illinois, Urbana-Champaign

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February 1983

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John F. Due, Professor
Department of Economics

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Zimbabwe, Zambia, Tanzania, Sudan

Abstract

The purpose of this paper is to review the trends in railroad transport in recent years in four African countries--Zimbabwe, Zambia, Tanzania, Sudan. The Zimbabwe system has by far the heaviest traffic volume, the Sudan Railways the greatest mileage and number of employees. Two of the systems show operating profits; all show overall deficits, but this is accepted in view of their contributions to development. Only the Zimbabwe lines can handle all of the traffic available to them; the situation is particularly bad in Tanzania and the Sudan. This problem and the inadequate service result primarily from deteriorated track (much of it now being rebuilt), inadequate equipment maintenance, and lack of adequate trained personnel. The governments place substantial stress on improved rail performance, primarily because of the general belief, supported by considerable evidence, that rail transport is substantially cheaper than road transport and less of a drain, for given traffic, on foreign exchange. Some loss to road transport is occurring because of continued use of value of service tariffs in all of the countries except Tanzania, which has shifted to a cost-based tariff.

Trends in Rail Transport in Four African Countries

Zimbabwe, Zambia, Tanzania, Sudan

John F. Due
Professor of Economics
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Rail transport in Africa began in the colonial days, the lines built partly for military reasons, partly to allow exploitation of mineral deposits, export of farm products, and import of manufactured goods. Typically built inland from the coast, they were not designed for inter-country trade, nor were they ideal for internal economic development. They were built cheaply, and to narrow guage, 1.067 meters ($3\frac{1}{2}$ feet) typically in the British colonies (but not in all), 1 meter in most others. After independence, one major line (Tazara) was built, some lines were extended, and some connecting links built. On the whole, however, despite some improvements, in many respects most systems have deteriorated in recent decades. It is the purpose of this paper to review the recent experience in detail in three African countries, Zimbabwe, Tanzania, and the Sudan, with some reference to the system in Zambia.[1]

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1. Two articles by the author in 1979 and 1980 covered a somewhat larger number of countries and were based on data up to 1976 for the most part: John F. Due, "The Problems of Rail Transport in Tropical Africa," Journal of Developing Areas, Vol. 13 (July 1979), pp. 375-93, and "The Economic Viability of the Railways of Tropical Africa," Journal of Development Economics, Vol. 7 (June 1980), pp. 263-72. Material in these articles is not included in this paper with minor exceptions.

Other earlier references include Anthony M. O'Connor, Railways and Development in Uganda, East African Institute of Social Research, East African Studies #18 (Nairobi: Oxford University Press, 1965); Rolf Hofmeier, Transport and Economic Development in Tanzania (Munich: Weltforum Verlag, 1973); Alan R. Prest, Transport Economics in Developing Countries (New York: Praeger, 1969); Arthur Hazlewood, Rail and Road in East Africa (Oxford: Basil Blackwood, 1964).

PART I. ZIMBABWE[1]

Zimbabwe is served more completely by rail service than most Tropical African countries, with 3400 km. of line, reaching all the major towns and economically developed areas. The lines handle substantial traffic within the country, as well as important export-import and transit traffic. The railway was built by the Rhodesian Railways, originally a private company later taken over by the Federation of Rhodesia and Nyasaland. The Rhodesia portion passed to that government following the breakup of the Federation, and was separated in 1965 from the northern portion, which became Zambia Railways. The line reached Bulawayo in 1897, built north from Cape Town via Botswana (then Bechuanaland) by the Rhodes interests in the 1890s to avoid the Boer states. A separate line from Beira to Salisbury (Harare) was completed in 1898, and the lines were joined shortly thereafter. The line north to Zambia was built shortly after the turn of the century. Two major lines came much later, a direct route to Lorenco Marques (now Maputo) in the late 1950s, and a connection with South African Railways at Beitbridge, completed in 1974.

As of 1983, the system consists of several major routes, plus a group of branch lines (Fig. 1).

1. The heavy-volume line from Harare south to Gweru (formerly Gwelo), where it forks:

(a) One line continues to Bulawayo, where it joins the line coming down from Zambia, which crosses the Zambesi at Victoria Falls, and continues on

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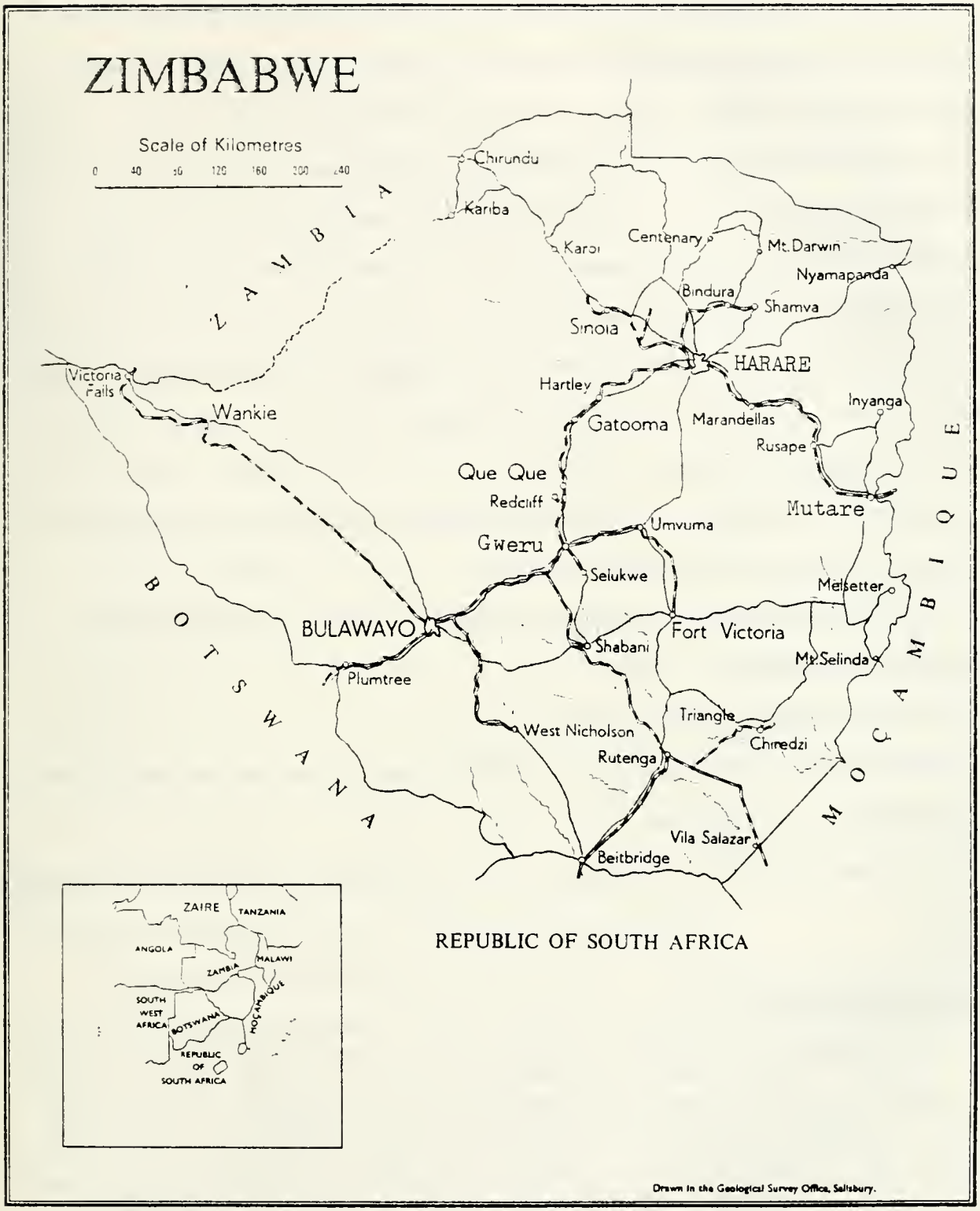
1. This portion of the paper is based on information provided by the National Railways of Zimbabwe; Zimbabwe, Ministry of Economic Planning and Development, Annual Economic Review of Zimbabwe, August 1981; Zimbabwe Central Statistical Office, Monthly Digest of Statistics, August 1982; "Transport: A Development Magazine Special Feature," Development (Harare), Sept. 1982, pp. iii-xxi; "NRZ Performance Improves," Commerce (Harare), June 1982, pp. 7-9.

Fig. 1



Source: Annual Economic Review of Zimbabwe, August 1981.

southward, via Botswana, to a connection with South African Railways at Mafeking. Zimbabwe Railways operates the line in Botswana, having taken it over from South African Railways, the last portion in 1966.

(b) The other line goes southeastward to Rutenga, where it forks, one line going east to a junction with Mozambique Railways at Chicualacuala, providing a direct line to Maputo, the other going south to connect with South African Railways at Beitbridge.

2. The major line southeastward from Harare to Mutare (formerly Umtali) and a connection with the Mozambique Railways.

3. The branch lines:

(a) North from Harare, to Shamva and Sinoia, servicing a major agricultural area and chrome mines at Sinoia.

(b) Gweru-Fort Victoria, a light traffic line, with some asbestos and farm product traffic.

(c) Gweru-Seluke, handling chrome ore.

(d) In the southeast, a branch off the Maputo line, serving the sugar producing area of Chiredzi.

(e) From a point near Bulawayo to West Nicholson, serving a manufacturing plant.

The Export Traffic Flows

For decades, the principal export and import traffic to the ports flowed through Beira (particularly from Harare and northern Zimbabwe), and through Maputo (traffic from Zambia and Zaire, and southern Zimbabwe). But a combination of loss of trained personnel and guerrilla activities in Mozambique have greatly restricted use of these two routes and the port of Beira. One freight train a day--about 400 tons--is handled through to Beira,

primarily export of tobacco and maize, with virtually no import traffic. The direct line to Maputo has not been operable for six months or more; some traffic moves through Maputo, but via the old route through South Africa with only a few miles of track in Mozambique. The consequence is that most of the port traffic is going via South Africa, to the Indian Ocean ports, especially Durban, and Capetown. The Capetown traffic is handled through Botswana, the Indian Ocean and Johannesburg area traffic via Beitbridge, with about equal volumes of traffic on the two routes. Much of the Zambia and Zaire traffic is handled in the same way. Tazara has been operating to only a small fraction of its potential capacity, the port of Dar es Salaam has been congested, and the Benguela Railway to the Atlantic coast is still not operating because of guerrilla activity in Angola.[1]

The use of South African rail lines and ports is not only contrary to the preferences of the governments of Zambia and Zimbabwe but it is also much more expensive. For example, for a typical carload shipment the rate from Harare to Maputo, 1262 km, is Z$820 , via Komatipoort in South Africa, 1,481 km and $1,359; via Durban, 2,081 km, $1,658. The hope of course is that the efficiency of Mozambique Railways and the ports will improve so that the traffic can again be routed via Beira and Maputo.

The largest volume of import traffic is in fertilizer, plus increasing numbers of containers; about 1,000 a month are currently being received in Harare. Maize and chrome are the largest export commodities. There is substantial local traffic--coal from Wankie (near Victoria Falls), to the smelters at QueQue and elsewhere, movements of ore, of steel, of maize and

1. It is reported that copper traffic from Zambia through Zimbabwe in mid 1982 was about 50,000 tons a month, from a previous figure of 20,000 tons. "NRZ Performance," Commerce, op. cit., p. 9.

other farm products, tea, tobacco, lumber, machinery, and some cattle. The Botawana line generates considerable cattle traffic, as well as coal and ore.

Table 1 shows revenue by type of traffic over the last decade. Coal, agricultural products, mineral products, and basic metal products are about of equal importance, but these yield in total only 38% of the freight revenue; the traffic is much more diversified than in many countries.

Track and Equipment. The railway was built to the 1,067 meter Cape guage used throughout southern and central Africa. The track is currently in good condition, although some will need upgrading in anticipation of heavier traffic volume; some 45 kg (about 100 pounds) per meter rail is currently being replaced by 54 kg (about 120 pound) rail.

As of the beginning of 1982, the railway had 275 diesel locomotives, of a great variety of different origins. During the year 61 new General Motors diesels were acquired from Canada and the United States. Commencing in 1977 the railway made the decision to rebuild many of its steam locomotives; it now has 87 rebuilt ones, all Beyer-Garretts. The work was done in Bulawayo; the engines were given new fireboxes, bearings, and boilers. They are used on freight and passenger trains from Bulawayo to Victoria Falls and Gweru. The decision was made because the country has extensive coal deposits but no oil. The intent is to use them at least for the next 10 to 15 years.

Decision was also made to begin electrification of the main lines in 1981; in 1983 the section between Harare and the yards south of Gweru will be completed, with electric locomotives acquired from Europe. Under present plans the electrification will be extended over the next several years to Bulawayo and Beitbridge.

Table 1

Revenue by Type of Traffic, National Railways of Zimbabwe, 1968-1982
Years ending June 30 except 1982

Z$000s

Year	Passenger Services	Agricultural Products	Coal	Minerals	Basic Metal Products	Other	Total*
1968	3,719	3,622	3,810	3,957	8,308	28,470	52,586
1969	3,802	3,144	5,435	3,649	10,698	30,055	57,401
1970	3,881	6,468	6,144	4,128	10,902	29,286	61,359
1971	4,064	5,052	5,338	3,528	11,963	30,732	61,280
1972	4,477	5,873	4,520	4,489	13,274	32,431	65,776
1973	5,038	5,963	5,156	4,458	9,492	32,834	63,692
1974	5,191	5,871	6,998	5,031	5,496	33,146	63,003
1975	6,032	7,144	5,971	6,022	6,516	38,812	71,666
1976	6,426	7,922	8,492	8,869	9,577	36,050	78,754
1977	6,308	8,995	9,479	9,973	9,858	37,039	83,273
1978	6,061	10,018	9,015	8,707	10,212	35,720	81,322
1979	5,220	13,649	11,694	9,788	19,103	41,624	102,841
1980	5,221	12,698	14,222	10,196	11,267	72,962	128,244
1981	8,113	17,216	14,969	13,058	10,035	88,137	153,969
1982**	9,113	19,398	17,489	12,148	11,868	84,453	157,882

* including miscellaneous
** through May
Source: Zimbabwe, Monthly Digest of Statistics, August 1982, table 17.2.

The system shops are located in Bulawayo, together with the general offices. The railroad builds its own freight cars and passenger coaches; as of early 1982 it had 13,000 freight cars and 460 passenger coaches. Shops are also located in Mutare.

A major new mechanical hump yard, capable of handling 96 freight trains (30 cars) a day was recently completed at Dabuka, south of Gwelo.

Passenger Service. The major passenger train operates overnight between Harare and Bulawayo, the two principal cities. Overnight trains also operate from Harare to Mutere, and from Bulawayo to Victoria Falls. The railroad has tried day trains but finds a preference for overnight service. At one time numerous through trains were operated to neighboring countries--to Lusaka and the Copper Belt in Zambia; from Bulawayo through Harare to Beira (daily), from Harare to Maputo twice weekly, and three times a week to Cape Town, three times to Johannesburg. The only one remaining of these (late 1982) is once a week service to Johannesburg, though there has been consideration of restoration of through service to Zambia (Zambia Railways service ends at Livingstone, Zimbabwe at Victoria Falls). Passenger service yields only 5% of total revenue, and the railway is not particularly interested in expanding it. There are still four classes, the first and second class having sleeper berths on the overnight runs. The number of passengers fell drastically after 1975, to one-third of the top year (1973) but has been rising since 1980.

Trends in Traffic Volume

Table 2 shows the figures of freight tonnage and passengers from 1972 through 1982. The freight trend has been irregular but upward, the 1981 figure being 45% above that for 1972. The traffic dropped in the Spring

Table 2

Freight Tonnage and Passengers Carried
National Railways of Zimbabwe, 1968-1982

Year	Total Revenue Tons 000s	Gross Ton KM 000,000s	Net Ton KM 000,000s	Passengers Carried 000s
1968	9,077	13,027	5,380	3,130
1969	9,500	13,471	5,615	2,857
1970	10,846	14,411	6,500	2,814
1971	10,768	14,283	6,293	2,782
1972	11,498	15,308	6,802	3,013
1973	11,598	15,194	6,628	3,236
1974	11,801	14,600	6,190	3,010
1975	12,018	14,686	6,141	3,127
1976	12,845	14,670	6,358	3,105
1977	12,108	13,957	6,104	2,613
1978	11,191	12,792	5,588	2,227
1979	11,621	13,391	6,149	1,574
1980	12,687	14,167	6,864	991
1981	13,153	13,540	6,610	1,580
1982*	11,310	11,774	5,717	1,678

*through May 31
Source: Zimbabwe, Monthly Digest of Statistics, August 1982, table 17.1.

of 1982 because of the depressed economy, but was still well above earlier levels. The patterns, however, of freight movements have shifted sharply over the years. Once most of the export traffic of Zambia flowed through Zimbabwe on the way to Indian Ocean ports; this was cut off by UDI (the Zaire traffic, which Zambia would handle, was not cut). This flow resumed somewhat after independence, aided by the difficulties on Tazara, but again was interrupted by the unsettled conditions and loss of trained personnel in Mozambique. Thus much of the traffic was shifted to South African ports and destinations. This is regarded as temporary--but may last for a period of years.

The traffic density is about 1,950,000 net ton miles per mile of line, despite the considerable mileage of currently light traffic lines.

As shown in table 3, the revenue has of course increased sharply in dollar terms over the years; there has, however, been an increase in real terms as well, as the greater tonnage suggests; between 1972 and 1982 the increase in real terms was 28%.

The Ability to Handle the Available Traffic

During the period of UDI, the railroad suffered serious problems of shortages of spare parts and inability to obtain new equipment. It was particularly short of locomotives and was forced to borrow substantial numbers from South Africa. Thus it almost voluntarily surrendered considerable traffic to road transport. By now, however, the railroad is functioning normally and efficiently again, and is seeking additional traffic, especially in bulk commodities which it can handle cheaply. It is not easy, however, to recover the traffic from road transport, particularly given the nature of the tariffs, as noted below. The system has suffered somewhat from loss of trained personnel. The number of whites, the most highly trained, has

Table 3

Financial Results, National Railways of Zimbabwe, 1968-1982
Years ending June 30, except 1982

Year	Operating Revenue Z$000s	Operating Expenses Z$000s	Operating Surplus Z$000s	Operating Ratio	Net Surplus or Deficit Z$000s
1968	52,586	40,651	11,935	77	- 2,180
1969	57,401	38,162	19,239	66	+ 2,989
1970	61,359	41,727	19,632	68	+ 1,678
1971	61,280	43,900	17,380	72	- 1,676
1972	65,776	46,624	19,152	71	- 1,926
1973	63,692	51,437	12,255	81	-10,996
1974	63,003	56,664	6,339	90	-19,139
1975	71,666	63,183	8,483	88	-21,226
1976	78,754	72,736	6,018	92	-29,119
1977	83,273	82,171	1,102	99	-36,912
1978	81,322	80,772	550	99	-35,697
1979	102,841	89,400	13,441	87	-28,965
1980	128,244	115,130	13,114	90	-32,151
1981	153,969	133,692	20,277	87	-32,681
1982*	157,882	139,287	18,595	88	-34,947

*through May 31

Source: Zimbabwe, Monthly Digest of Statistics, August 1982, table 17.1.

fallen from 8000 to 3500 over recent years, and training of Africans has not been adequate to offset this loss.

The railroad does operate some road transport, mainly to reach points not served by the rail lines, stressing bulk commodities, which the independent road transport firms do not particularly want.

The Rate Structure

The rate structure is still one typical of rail tariffs of the past. There are 14 rate classes, plus a tank car rate. The first 10 class rates are expressed in units of 100 kg, commodities grouped according to loading characteristics and value. The high value, low density commodities, particularly luxury goods, receive the highest rates; machinery and groceries and other less valuable items, the intermediate; building materials, for example, the lower. Classes 11-14 consist of the bulk commodities, the rates shown per 1000 kg, such as coal, minerals, and agricultural products, with low rates. Export shipments receive lower than normal rates. Shipments under 100 kg (about 220 pounds) move at a flat rate, irrespective of distance.

This is the type of tariff that, throughout the world, has resulted in loss of high value traffic to road transport, and clearly this is occurring in Zimbabwe. On the other hand, it concentrates on the railways the commodities they can most efficiently handle--but makes the covering of cost more difficult.

Losses. As shown in table 3, the railroad has consistently shown an operating surplus although less in real terms than in the early seventies. But not since 1971 has this been sufficient to cover depreciation and interest costs, and for the 1982 entire year the deficit is about $42 million (at current exchange rates about U.S.$45 million). Losses in the last few years have

been aggravated by the rise in petroleum prices, very sharp increases in wages following independence, and governmental action in eliminating payments for car use due from Mozambique. The enterprise is of course a government statutory corporation, and the deficit is financed out of tax revenue. While there is hope that the deficit can be reduced materially as business activity in the country revives, elimination of the deficit is not seen as feasible in the foreseeable future; it is regarded as necessary for maintenance of an efficient railroad system essential for economic development. Nearly $600 million investment is planned for the railways in the next five years.

The operating cost per ton km is about 2¢(Z) or 3.3¢ per ton mile (slightly higher in equivalent US cents), the total cost about 3¢ per ton km, or 4.8¢ per ton mile. These are comparable to those of other relatively efficient rail systems. There are 20,000 employees.

PART II. ZAMBIA AND TANZANIA

Because Zambia and Tanzania share one major rail line, Tazara, the two countries will be discussed in a single section. The principal carrier in Zambia is Zambia Railways, in Tanzania, Tanzania Railways Corporation. About half of Tazara is in each country.

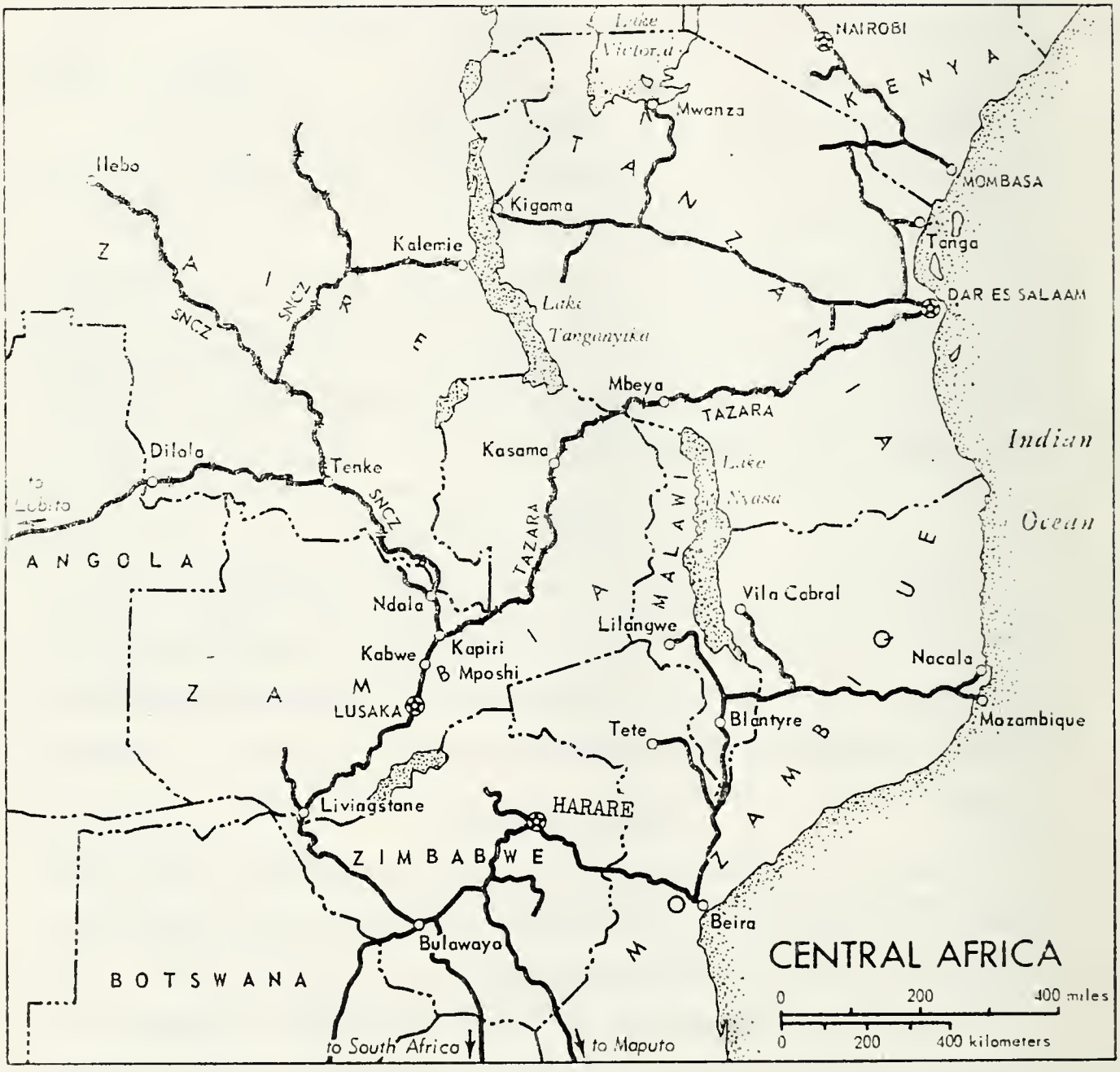
ZAMBIA RAILWAYS

Detailed data on Zambia Railways have not been assembled, but a brief summary is included because of the interrelationship of the railways of the country with those of Zimbabwe and Tanzania.

Much of Zambia has never had rail service. The Zambia Railways line was built by Rhodesian Railways, crossing the Zambesi at Victoria Falls in 1903, reaching Kabwe (then Broken Hill) in 1906, the Copper Belt (then little

Fig. 2

Railways of Zambia and Neighboring Countries



developed) in 1909. Commercial agriculture and trade and industrial activity concentrated along the "line of rail"; the geographical pattern of economic development was influenced by the railway perhaps more than in any other country. The main line extends roughly 1000 km northerly from the river crossing to the Copper Belt, connecting with Tazara at Kapiri Mposhi and with the Zaire rail system at the border. Apart from branches in the Copper Belt, the only other branch reaches the coal mines at Maamba. The line from Livingstone to Mulobezi, serving the sawmill, is operated by Zambia Railways for the government. Fig. 2 shows the line and those of neighboring countries.

While there is considerable in-country traffic, in coal, maize, and other goods, much of the traffic is to or from the ports. Table 4 shows the changing patterns of the handling of import and export traffic. Originally most was channeled through Rhodesia and virtually all was rail. A portion, particularly import traffic, went via the Benguela Railway to the Atlantic port of Lobito. With UDI in Rhodesia and eventual closing of the border, a substantial portion was shifted to Dar es Salaam, first by road, then with the completion of Tazara, primarily by rail. After 1976 the Lobito route--the best in many ways for merchandise imports--was closed by unsettled conditions in Angola and is not yet functioning in 1983. But with independence in Zimbabwe, use of the southern route resumed--particularly because of problems with Tazara and the Port of Dar es Salaam. Thus in the last two years, while Tazara handles the bulk of the export traffic, the import traffic is divided about equally between the Dar route and that via Zimbabwe. The use of Tazara is of course disadvantageous to Zambia Railways on the Copper Belt traffic, since it has only a very small portion of the total haul. There is considerable road transport competition, with increasing amounts on the southern routes. For traffic between Harare and Lusaka and the Copper Belt, the road mileage is

Table 4
Percentage of Zambia Import and Export Traffic via Various Routes
Selected Years 1953-1981

Exports

	1953	1963	1967	1972	1973	1975	1976	1979	1980	1981
Lobito-Zaire (rail)	0	0	23	20	54	40	15	7	6	4
Dar es Salaam (road and rail)	0	0	31	26	35	51	75	52	59	66
Malawi (road)	0	0	8	1	5	9	5	2	.5	--
Mozambique (road)	0	0	0	0	0	1	4	0	0	0
Zimbabwe (rail and road)	100	100	34	54	1	0	0	38	34	29
Kazangula (road)	0	0	0	0	0	0	0	neg	0	0
Kenya (road)	0	0	0	0	6	neg	1	0	0	0
Air freight	0	0	5	neg	0	0	0	1	.5	.6

Imports

Lobito-Zaire (rail)	--	--	--	11	49	29	neg	neg	neg	0
Dar es Salaam (road and rail)	--	--	--	19	23	43	76	47	47	46
Malawi (road)	--	--	--	0	13	13	9	4	.4	.5
Mozambique (road)	--	--	--	0	0	3	8	3	0	2
Zimbabwe (rail and road)	--	--	--	66	4	0	0	44	51	50
Kazangula (road)	--	--	--	neg	1	5	1	.2	0	neg
Kenya (road)	--	--	--	0	8	3	3	0	0	0
Air freight	--	--	--	1	3	2	3	3	2	2

Traffic on the Dar es Salaam route was all road until 1975, about equal rail and road 1976 and predominantly rail since.

The Mozambique figure does not include traffic via Zimbabwe to Mozambique ports.

Source: Annual Reports, Bank of Zambia.

substantially less than the rail mileage. The inability of the railway to handle all the traffic available, particularly in maize, has of course increased the relative importance of road transport. Nevertheless rail remains the dominant form of transport. Unlike the Zimbabwe situation, much road transport is handled by two large parastatals, Zambia-Tanzania Road Service and Contract Haulage.

Table 5 shows the relative division of import and export traffic between road and rail in the last three years.

The railway handles substantial transit traffic between Zaire and the countries to the south, copper for export via South Africa, and maize from Zimbabwe and South Africa. This traffic continued during the period in which Zambia closed the border with Rhodesia to its own trade.

Two passenger trains a day are operated on the line, from the Copper Belt through Lusaka to Livingstone; the schedules are shown in Fig. 3.

The railway has had difficulties in handling the available freight traffic ever since its formation from Rhodesian Railways, despite substantial Canadian management and training assistance at times and three World Bank loans. The track and signalling systems are superior to those of most tropical African countries. The major problem has been inadequate trained staff and shortages of locomotives and freight cars. The entire system is dieselized; but maintenance has not been adequate, and exchange problems have created the usual parts shortages. There has been a constant shortage of freight cars; the railway in part blames this on Tazara, on which turnaround time has been very slow, and at times numbers of cars have been locked in Angola. On the other hand the system has far more South African Railways cars, some 2400, than the agreed upon limit of 1648.

There has been some improvement in 1982, and the traffic does move, but the line is not operated to its potential capacity.

[illegible] RAILWAYS PASSENGER TRAIN TIMETABLE - DAILY

LUSAKA-LIVINGSTONE/[illegible] BOUND

Luangwa Train 7	Arr:	Lusaka from Kitwe	05.35 hrs
	Dep:	"	06.05 hrs
	Arr:		7.40 hrs
Kafue Train 1	Arr:	Lusaka from Kitwe	15.30 hrs
	Dep:		15.45 hrs
	Arr:		00.40 hrs

LIVINGSTONE - LUSAKA.

Luangwa Train 8	Dep:	23.00 hrs
	Arr:	11.10 hrs
Kafue Train 2	Dep:	8.00 hrs
	Arr:	16.55 hours.

LUSAKA-KITWE/NORTH BOUND

Luangwa Train 8	Arr:	Lusaka from Livingstone	11.00 hrs
	Dep:		11.40 hrs
	Arr:		22.15
Kafue Train 2	Arr:	Lusaka from L/Stone	15.55
	Dep:		17.10
	Arr:		00.40

KITWE-LUSAKA.

Luangwa Train 7	Dep:	17.00 hrs
	Arr:	05.35 hrs
Kafue Train 1	Dep:	08.00 hrs
	Arr:	15.30 hrs

CHARGES:	Lusaka to Livingstone	Kafue train	K8.70
	" "	Luangwa train	K5.80
	Lusaka to Kitwe	Kafue train	K7.30
	" "	Luangwa train	K4.80

Table 5

Foreign Trade by Mode of Transportation
(metric tons) 1979-1981

	1979		1980		1981 (a)	
	Total Trade	Percent	Total Trade	Percent	Total Trade	Percent
Road	364,627	24.7	447,037	26.8	305,499	21.9
Rail	1,090,320	74.1	1,200,720	71.9	1,070,909	76.9
Airfreight	12,010	1.2	23,143	1.3	16,503	1.2
TOTAL	1,471,957	100.0	1,670,900	100.0	1,392,911	100.0

Source: Bank of Zambia Annual Report 1981.

[a]Including lube oil.

Despite its operational difficulties, Zambia Railways has managed to show an operating surplus, including depreciation in cost, except in 1975 and 1981. The 1981 loss, of K 1.9 million, was due to the inability to raise rates sufficiently to offset higher costs. Rate changes require government approval, even though the railway is a statutory corporation. But interest costs are not covered.

There have been long standing plans for additional railroad construction in the country, particularly to connect with the Malawi system west of Lilongwe and with the Mozambique system at Tete. Currently the Malawi line is being extended to the border, and, as indicated in Fig. 4, Zambia is building from the border to Chipata, one of the major cities in the country without rail service. But a long gap will remain to connect this with the Zambia network.

Fig. 4

ZAMBIA
RAILWAYS

CHIPATA-MCHINJI RAIL LINE CONSTRUCTION PROJECT

This general information is for all those who can supply crushed stone ballast to Zambia Railways for use in the new railway line under construction from the Malawi-Zambia border to Chipata.

The requirement is of 50mm size approximately 20,000 cubic metres for the use in the track. Additional stone will be required for building activities by local contractors. The requirement is at a specified point at Chipata and the supply is to be completed within 12 months from January 1983. All those who can supply this type of crushed stone may register their names with the undersigned giving particulars of their plant and machinery in their possession or on order past experience etc, before 14th November 1982.

Chief Civil Engineer
Zambia Railways
Box 80935,
KABWE

R42507

Reproduced from Times of Zambia, Nov. 2, 1982

TAZARA

Tazara consists of one line extending 1,885 km (1,158 miles) from a connection with Zambia Railways at Kapiri Mposhi to the harbour at Dar es Salaam, with 1.067 m. guage. It serves Mbeya, one of the major cities in Tanzania not previously served by rail, but not Iringa, the other major city in southwest Tanzania; much of the area served is relatively undeveloped. To date the line has handled primarily Zambia traffic, copper outbound, fertilizer, grain, and manufactured goods inbound. The line, built by Mainland China and completed in 1975, was one of the major rail construction projects in the world in the last half century, and freed Zambia of dependence on the southern route. But in terms of performance it has been a disappointment. It has handled a substantial volume of traffic more cheaply than road transport, but not to the extent anticipated. It is difficult to get adequate scientific explanations of the problems. Some of the track was not well located in terms of water runoff. The basic trouble appears to be inadequate trained personnel, particularly for management and equipment maintenance. It has been constantly short of locomotives, which have not been maintained well. They are diesel hydraulic, rather than diesel electric, and neighboring roads cannot assist. Train delays have been serious, with a very slow turnaround time, tieing up its own and Zambia Railways freight cars. Part of the trouble has arisen from congestion in the port of Dar es Salaam and the delays in clearing Zambia bound traffic because of lack of foreign exchange. The line has been so short of personnel and equipment that at times it has suspended passenger service entirely; currently it is running this service only once a week. The line has great potential, and will be of growing importance for Central Africa. But currently it has a long ways to go for efficient operation.

The line has about 2200 freight cars and 100 diesel locomotives, with a staff of about 10,000. In recent years it has averaged about 1 million tons of freight (900 million ton kilometers), about 495,000 ton km/km or the same ton miles per mile. This not a heavy volume of traffic. It carries about 1.3 million passengers a year.

The tariff structure is the old value of service type, adapted in part because much of the traffic is not vulnerable to road transport competition. The copper traffic allocation is controlled by the government of Zambia. Commodities are classified into 11 categories, the bulk agricultural commodities falling into the 11th class (lowest rate). The rates taper substantially but not to the extent found in many countries. The scale of rates as of 1981 is shown in table 6 in Tanzania shillings. Copper, in scale 6, bears a relatively high rate, about 5 US cents per ton mile.

Table 6
Tazara Freight Rates (TShs/ton)

Scale	100 km	200 km	500 km	1000 km	1500 km
1	189	272	417	637	857
2	168	231	361	566	771
3	152	199	316	505	694
4	136	178	293	458	620
5	121	162	259	411	562
6	110	151	235	360	486
7	100	139	220	343	463
8	89	124	195	310	423
9	79	112	176	280	386
10	73	104	167	265	383
11	37	65	143	261	376

Passenger fares are based on a straight mileage basis, class 1, 30t¢ per km; 2, 16.5 tc, 3, 7.5 tc. The second and third class rates are about 25% greater than those of Tanzania Railways.

TANZANIA RAILWAYS

The principal railway system of the country is that of Tanzania Railways (TRC), with 2800 km of meter gauge track and 16,000 employees.

Lines

There are two distinct lines, with a connecting link between them (Figure 5). The principal portions of both were built by the German colonial administration prior to World War I.

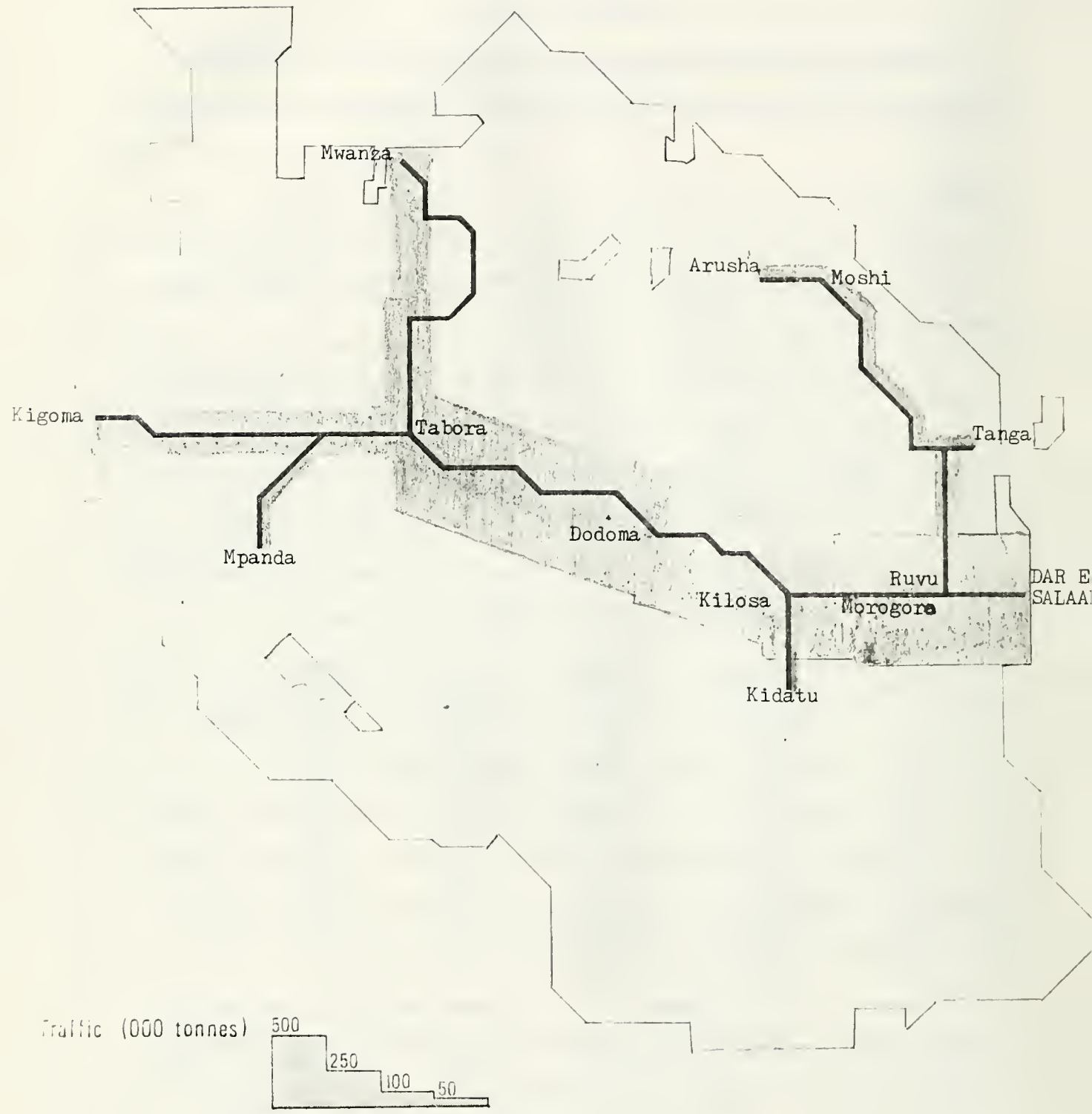
1. The Tanzania Central line, extending from Dar es Salaam westward via Morogoro, Dodoma and Tabora to Kigoma on Lake Tanganyika, completed in 1914, 1,255 kilometers. This is by far the heaviest traffic line. There are three branches:
   (a) Tabora-Mwanza, on Lake Victoria, 379 km, started in 1914-15, completed in 1928, also a heavy volume route.
   (b) Tabora south to Mpanda, 213 km, built in 1947.
   (c) Kigoma south to Mikumi (1958) and on to Kidatu (1965) where it almost touches Tazara, 108 km.
2. The Tanga line, 437 km, begun in 1895 (thus the oldest in the country), reaching Moshi in 1911, extended to Arusha in 1929.

These are connected by the Link line, Ruvu to Mruazi, built in 1963, 188 km. Before that time the lines were not connected.

There is an unused segment, 31 km, between the Tanga line and the Kenya border, cut with the closing of the border. This line, if operating, would allow through service from Nairobi to Dar es Salaam.

Two lines have been abandoned: an extensive network in the south extending inward from Mtwara, built as a part of the ground nut scheme and abandoned following the collapse of the scheme, and a line to

Fig. 5



Source: CIDA, Tanzania Railway Transport Sector Study.

Kinyangari in the Singida district, abandoned after less than 20 years because it generated so little traffic.

Management of the system was united with the Kenya-Uganda lines in 1948, to form East African Railways, but this was dissolved in 1975, following the breakup of the East African Community.

An intensive study of the system has recently been completed by the Canadian International Development Agency (CIDA).[1]

The Physical Plant

In general, the physical plant is in fair condition and traffic does move; derailments have increased somewhat but are not frequent. But, as noted subsequently, there are serious limitations which make it impossible to move all available traffic.

Rail: The largest segment of track has had 60 pound rail, the central line to milepost 310, the Mwanza branch and the line from Tanga to Moshi. The remainder of the main line is 56 pound rail--the original rail laid by the Germans 1908-1914, with the original steel sleepers. The portions from Moshi to Arusha and the Mpanda branch have 45 and 50 pound rail, as does part of the link line. These are the three weak segments, not capable of handling the larger diesels, a problem of particular seriousness on the link line. The rail is in surprisingly good condition, though a third is over 70 years old, but some is worn. The CIDA study recommends the installation of 80 pound rail on the entire main line and 60 pound rail on the others, to allow freight train speeds up to 45 MPH. A portion of the main line has already been changed.

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[1] Tanzania Railway Transport Study, 12 vol., Dar es Salaam and Ottawa, May 1981. This section is based primarily on the CIDA report and discussions with CIDA personnel.

Most lines have gravel ballast (Mpanda is an exception) but it is in bad shape in many areas. The link line is particularly troublesome because it runs through swampy areas.

There are typically 2,240 ties (sleepers) per mile, primarily steel. Consideration is being given to concrete ties, which lessen the drain on foreign exchange; they are satisfactory if rails are welded and the joints staggered.

The maximum grade is 2.2% against westbound traffic, between Dar es Salaam and Morogoro, unfortunately the heaviest traffic portion of the line. The sharpest curve is 8°. One portion of the line in the far west is subject to flooding.

Locomotives: As of mid 1982, the line has 116 diesels, of 9 different types, from Germany, the U.K., India, and Canada. The newest and largest are MLW built (Canada). The diesels are as follows:

Class	HP	Number
88	2050	35
87	1840	8
73	1380	15
72	1240	2
64	760	24
Other	320 or less	32

The line still has a number of steam locomotives, reported as 63 in 1979. These were being used in some line service as late as 1980; currently they are used only for switching, in Morogoro, Tabora, and a few other locations. Most are in a bad state of repair. The present plan is to phase them out as soon as possible, but there is some thought of keeping and rebuilding the best ones. They are oil burners, and

there would be little gain in keeping them unless they were converted to coal.

Typically one diesel is used on a freight train, 28 cars (1,350 tons) being the train length limit up to Morogoro, as the couplers will not stand longer trains. But two diesels are frequently used to Morogoro and sometimes beyond. All trains on the main line change engines in Morogoro, location of the diesel shops, and Tabora. The Morogoro shops are new and not fully operative, mostly for lack of personnel. The diesel repair shops of East African Railways were located in Nairobi; when the system split up, TRC was left without such facilities until the new shops were built.

Typically about 60% of the road engines and 51% of the switchers are available for service, a very low figure by comparison with most railroads, due to lack of trained personnel and spare parts.

Freight Cars: The line has some 3,800 freight cars (wagons); 800 of these are the old, short, two axle cars. About 70 percent of all cars are in good or excellent condition. The cars are air brake equipped, but the couplers are not automatic. Typical capacity is 33 to 38 tons. The use of automatic couplers would allow longer trains, but the CIDA study concludes that the change would not be economic. Average turn-around time for freight cars is 21 days.

The line has a total of 165 passenger cars, over 30% of which are more than 30 years old. There are not nearly enough cars to handle the number of persons seeking to travel. A total of 110 cars are on order; a number from Sweden were delivered late in 1982.

Containerization: While there is no piggyback operation the use of containers has been growing. They are particularly important for the cross lake transit traffic, simplifying the loading and unloading. They are also used extensively for up country construction materials, and for export of tobacco.

Standard flat cars are still used for the containers.

Operation

Freight trains are typically operated with a crew of 2, passenger trains, 3. Trains are limited to 35 mph speed, but with many 10 mph slow orders. On most of the system a token technique is used to control train movements. When a train enters a segment of line, the engineer receives a metal token from a mechanism connected to the next station by wire; when he has done so, the token at the next station cannot be removed until the train has cleared. This is a virtually fool proof system to avoid train collisions, but does not function when the wire communications are not operating. There is no signal system; control is entirely through the stations. The only exception to the use of the tokens is on the lines from Tabora to Kigoma and Mpanda, operated with a paper train order system.

Passenger service is operated daily on the two main lines. On the central line, the train leaves Dar es Salaam at 7 p.m., arrives in Dodoma the next morning, Tabora in the evening, and Kigoma and Mwanza the next morning, averaging about 20 mph. Three classes of service are provided and reservations are required. Daily service is operated from Dar to Moshi, but not to Arusha.

Figure 5A. A Typical Railroad Station Scene in Tanzania--Tabora

Source: CIDA, Tanzania Railway Project Study.

In 1979, passenger train on time performance was 27%, but the present figure is reported to be better.

Non-rail Operation

TRC operates vessels on Lakes Victoria and Tanganyika, including a 42-car ferry from Mwanza to Bukoba and Musoma, which do not have direct rail service. Only the old Liemba, a passenger vessel, is operated by TRC on Lake Tanganyika, but private carriers provide service across the lake.

The system operates road transport service from Dar es Salaam to Iringa and Mbeya, Iringa to Moshi, and Mwanza to Bukoba. Luxury bus service is operated to Iringa and Mbeya, but most regular bus service is provided by private firms.

Freight Rates

The East African Railway tariff was of the traditional value of service type with low rates on farm products and export traffic. After TRC was formed, a completely new tariff was developed, based strictly on cost of handling differences. There are only four classes of commodities, based on loading characteristics: LCL, 2: 10 ton loads, 3: 25 ton loads, 4: 30 tons and over. Rates taper with distance but not to the extent in the U.S. Typical rates are as shown below, together with rates per ton/km and a comparison with Tazara rates. On the more valuable commodities, TRC rates are much less; on less valuable commodity, shorter distance shipments, the rates are higher. In general, as the table indicates, TRC rates are lower than those of Tazara (Table 8).

The rate per ton/km falls roughly in half between 100 and 1000 km.

Table 7

Tanzania Railway Rates 1981

TRC General Goods Rates (TShs/ton except containers)

Scale	100 km	200 km	500 km	1000 km	1500 km
1	126	144	211	389	567
2	89	103	186	289	389
3	53	89	161	248	348
4	45	85	142	228	329
Livestock	55	67	103	165	226
Petrol	36	70	143	286	435
Containers*	980	1200	1850	3100	4500

*Total charge.

TRC General Goods Rates (Tshs/ton-km)

Scale	100 km	200 km	500 km	1000 km	1500 km
1	1.26	.72	.42	.39	.38
2	.89	.52	.37	.29	.26
3	.53	.45	.32	.25	.23
4	.45	.43	.28	.23	.22

Table 8

Comparison of Typical Tazara and TRC Rates

	100 km		200 km		500 km		100 km	
	TAZARA	TRC	TAZARA	TRC	TAZARA	TRC	TAZARA	TRC
Copper	100	45	151	85	235	142	360	228
Coffee	89	45	124	85	195	142	310	228
Sugar	73	45	104	85	167	142	265	228
Cement	37	45	65	85	143	142	261	228
Cotton	37	45	65	85	143	142	261	228
Fertilizer	37	45	65	85	143	142	261	228

One consequence of the cost-based tariff is that the rate as a percentage of the selling prices of the goods is very low on valuable goods; examples, for typical distances, include 1% on coffee and 2% on petroleum products, vs. 14% on sorghum and 23% on cement. This type of tariff lessens the danger of loss of traffic to motor transport, and is basically economically justified but it does sacrifice potential revenue on the high value commodities, so long as they stay on rail.

In general, rail rates are lower than truck rates for distances over 150 to 200 km. Typical figures are as follows:

	Distance (km)	Rate Ts per ton	
		Rail	Truck
Dar es Salaam - Morogoro	203	90	150
Dar es Salaam - Arusha	637	165	350
Dar es Salaam - Mwanza	1229	276	1500

The CIDA study concludes that truck costs are from 3 to 7 times the rail costs except on the shorter hauls. But truck time is much faster; for example, on a long haul, 4 days (despite poor roads) vs. as much as 30 days. CIDA studies conclude that even with adjustments for time differences, rail is still typically cheaper, but of course less so.[1]

Traffic Flows

As shown in Figure 5, the main line from Dar es Salaam (where 50% of the traffic originates) to Tabora has the heaviest flow, with the Morogoro-Ruvu (junction point for the link line) portion the heaviest segment on that line. Beyond Tabora, the Mwanza line has somewhat heavier

[1] CIDA study of truck costs shows that with 80% capacity use, costs are .65Ts per t/km with paved roads, .91 with earth roads.

traffic than the Tabora line. The link and Tanga lines have much lighter traffic, under 100,000 ton km per km, and the other two branches under 50,000. By comparison with other systems, even the 500,000 main line figure is not heavy.

A few major traffic flows can be noted briefly. Petroleum and cement move on all lines; all petroleum moves by rail beyond Morogoro in rail territory with minor exceptions; grain, Dodoma to Dar es Salaam (Dar); sugar, Kigoma to Dar; coffee, from Moshi to Tanga and Dar; livestock from Tabora to Dar; cotton and cattle cake, Mwanza to Dar; fertilizer, Dar to Tabora, and on the Tanga line; sisal, Morogoro to Dar and Moshi to Tanga. Taffic is well balanced, but 20% consists of petroleum and cattle, requiring equipment in which return loads cannot be handled.

In a sample month (June 1978), petroleum yielded 16% of total freight revenue and grain 10%; there was then a sharp drop to 7 for cement, 6 for coffee, 4 for livestock, 4 for tobacco. No other product exceeded 1%--though general miscellaneous freight, which includes most manufactured goods yields 46%.

Major truck routes are those between Dar, Iringa and Mbeya, and Dar and Tanga to Arusha. There is little effective truck competition to the western portion of the central line, as there are virtually no roads.

Passenger Fares and Traffic

Passenger fares are based on a straight distance basis: .29 Ts per km first class; .13, second; .07, third; and .05 on long distances. Thus a 500 km third class ticket costs 30 Ts or about $US3 at current exchange

rates. Comparable fares for typical points are as follows (in Tanzania shillings).

	Rail			
	1st	3rd	bus	air
Dar es Salaam to				
Morogoro	60	14	22	na
Tabora	250	85	121	665
Arusha	187	37	73	490
Mwanza	360	69	148	740

Thus third class rail is the cheapest, bus being about the same as second class rail. First class is about 6 times third class, and air about 2 1/2 times first class rail, and from 8 to 12 times third class rail. The problem is that reservations on rail are difficult to get, often requiring a month in advance. The unreserved third class cars on the secondary mixed train are very crowded.

Passenger traffic, which yields 18% of total revenue, a comparatively high figure, is heaviest on the Dodoma-Tabora portion.

The Decline in Traffic Volume

While detailed figures year by year are not available, it is clear that the total volume of freight and passenger traffic has declined, by about 7% a year, since 1972. In that year, total tons of freight carried was 1,680 million; in 1979 it was 850,000, and the 1982 figure is still lower. Passengers carried in 1972 were 4.2 million, in 1979 1.8 million. The railroad is estimated by CIDA to handle about 43% of the total freight transport, compared to 54% by road and 3% by water. Rail handles about 32% of passenger travel. While some of the loss may be due to the closing of the border with Kenya, most of the decline is from all indications

the product of one cause: the inability of the railway to handle all the traffic available.

The CIDA study concludes that the railway handles only 48% of the traffic available to it. The following percentages show the portion of the total traffic that trucks have obtained simply because of inability of the railroad to move it: petroleum products, 50; cement, 64; grain, 72; sugar, 83; coffee, 24; fertilizer, 70. The result is a substantial loss to the economy in the form of higher costs estimated to be Ts 220 million in 1979, and heavier drain on foreign exchange.

Revenue and Earnings

It is impossible to carry revenue information back beyond 1975 and the figures since that date are not entirely accurate. But Table 9 gives a picture of the general trends.

Table 9

Financial Statistics, Tanzania Railways, 1975-79

	millions of Tanzanian shillings				
Category	1975	1976	1977	1978	1979
Revenues	290.7	329.6	336.5	323.2	360.3
Operating Expenses	206.4	183.7	322.7	336.0	297.2
Operating Margin	84.3	145.9	13.8	-12.8	63.1
Depreciation	35.0	35.0	35.0	33.3	60.8
Interest	30.0	30.0	30.0	11.6	28.4
Net Earnings	19.3	80.9	-51.2	-57.7	-25.3

Thus revenue has increased despite the loss of traffic because of higher rates, but has fallen in real terms. The line showed a net profit in 1975 and 1976, deficits in the next three years, but an operating profit (not including depreciation) in all years except 1978.

Apparently 1982 will show a slight profit. Thus the financial picture is not different from those of most African lines. The problem, as noted, has been the inability to handle more than half the traffic available, resulting in use of much more expensive road transport, greater foreign exchange drain, further destruction of roads, shortages of goods up country, inability to move out export crops. Road transport itself has had many problems centering around shortages of fuel, parts, and bad roads--and thus a considerable portion of the traffic that the railroad cannot handle simply does not move at all.

Figure 6

This advertisement is hardly consistent with the inability of the railway to move the traffic.

From Tanzania Daily News, November 1982.

Causes of the Problems

The basic situation is one of serious underutilization of the line. Old as the track is, it is not in hopeless condition. While it is impossible to measure the relative effects of various difficulties, the CIDA report and discussions with CIDA personnel suggest the following sources of the problems:

1. Communications. Perhaps the most serious trouble is bad communications, within the yards and between stations and trains, with no good central traffic control. It is difficult for personnel in the major yards to communicate with

one another, and no one knows exactly where trains are. The token system is almost proof for preventing collisions, but it slows down service, particularly when something goes wrong with the communications lines connecting the stations. It is surprising that the passenger trains are able to run on time as well as they do.

2. Poor ballast. Most of the system has rock ballast, but it has deteriorated seriously. This is the prime cause of slow orders, thus resulting in substantial lapsed time, adding to cost and poor service.

3. Congestion at Kigoma and Mwanza, resulting in serious delays and poor utilization of equipment. The problem arises with the translake traffic, to Bukoba and Musoma in Tanzania, and to Uganda, Burundi, Rwanda, and Zaire. While Uganda traditionally shipped through Kenya, with which it has direct rail connections, political considerations since the overthrow of Amin have increased preference for shipping via Tanzania. The transit traffic across the lake to the other countries has long been important; the Zaire railways do not extend directly to the Atlantic ports, the route via the Benguela Railway to Lobito has not functioned in several years, and the route to the south is long and costly.

The difficulty is that the ships on the lakes and the transshipment facilities are hopelessly inadequate. Only one vessel can handle freight cars. There is no "bridge" at Bukoba for running the freight cars off the ship (there

is at Musoma, one of the few cities in the world that has railroad tracks but no rail connection to the outside world). The remainder of the freight has to be unloaded from the rail cars and transferred to ships; this is a very slow and laborious process, particularly because the ships are old and careful balancing of cargo is necessary. The system never catches up--on any day there may be 400 cars bottled up in the yards at Mwanza. To prevent hopeless congestion many cars are held at Tabora until there is space at the two ports. The result is to delay greatly the shipments to cross lake ports and to aggravate the shortages of freight cars for all purposes. There is some belief that if the system acquires more freight cars they will simply end up in the jam at the lake ports.

4. Lack of adequate equipment maintenance facilities. This has been a serious handicap in past years for both diesels and freight cars. The completion of the new facilities at Morogoro should help this work materially--although this was not the ideal location for the shops and trained personnel are not yet available.
5. The problem, common in all African countries, of lack of trained manpower, in management and many aspects of operation, including equipment maintenance. Thus overall control of the system has been inadequate, as well as some specific aspects of work.
6. Shortage of freight cars, aggravated by the slow orders and the port congestion.
7. Shortage of spare parts resulting from lack of foreign exchange.

Proposed Changes

The CIDA study and similar work by SIDA, the Swedish aid organization, on the Tanga line, offer a number of priority proposals, in some of which the aid organizations have provided assistance.

1. Specifically, CIDA proposes, for the central line, an investment of $US 780 million over the next 20 years, of which, in millions, $280 would go for freight cars, $92 for locomotives, $75 for passenger cars, and $140 for track improvement. The estimated rate of return is 15%. More specifically, major proposals include the following:

   (a) Major track restoration, including the replacement of all rail on the central line by 80 pount rail, replacement of light rail by 60 pound rail on other lines, new sleepers, and complete reballasting.

   (b) Improvement of communications, with stress on microwave, to facilitate train movements and control over equipment.

   (c) A series of steps to end the congestion at the lake ports, including ultimately, additional car ferries.

   (d) Improved training facilities generally.

   (e) Additional locomotives, freight cars, and passenger cars, as noted above.

   (f) Additional repair facilities.

   (g) Experimentation with concrete sleepers.

   (h) General improvement of control facilities to improve car and locomotive utilization.

   (i) Priority importation of spare parts.

   (j) Higher rate.

   Longer range considerations include possible conversion of gauge to the 1.067 meter gauge of the other southern and central African lines. It is impossible to lay a third rail as only

2 5/8 inches would separate the two. Thus the change would have to be made all at once. The change would allow interchange of equipment with Tazara and with the lines in Zaire (although Tazara couplers are different), but would make it impossible to restore interchange with the Kenya-Uganda lines unless they change as well. Cost is estimated at about $85 million.

2. Consideration of building a new line from Arusha to Musoma, thus lessening pressure on the cross lake transfer and increasing potential service to Uganda.

Canada has provided substantial assistance, with management and technical advice and training and financing of equipment and track improvement. Sweden has aided on the Tanga line.

Government Policy

The government of Tanzania, in its recent Structural Adjustment Program,[1] designed to move country out of its economic malaise, stresses improvements to the railway. A key element in the program is to maximize use of the railways in order to lessen the use of more expensive road transport and foreign exchange drain, thus planning for rehabilitation of the railway and an attempt to make greater use of Tazara. A Ministry of Agriculture report, National Food Summary,[2] concludes "The railway represents the cheapest means of transport but the total haulage is way below the potential. Both Tazara and Tanzania Railways are in

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[1]Tanzania, Ministry of Planning and Economic Affairs, Structural Adjustment Program for Tanzania, Dar es Salaam, June 1982, pp. 28-31.

[2]Tanzania, Ministry of Agriculture, National Foods Survey, Dar es Salaam, May 1982, p. 19.

urgent need of rehabilitation." Among specific suggestions is one to shift fertilizer transport from road to rail.

PART III

SUDAN

The Sudan Railways constitutes the largest rail system in Tropical Africa, with 4,756 km (almost 3,000 miles) of line. Except for the Southern Region, which is reached only marginally at Wau, the settled areas of the country are well served. Figure 7 shows the lines, Table 10 the lines and the dates of completion. The first line, built south from Wadi Halfa along the Nile as a part of the military expedition to rescue General Gordon, was ultimately abandoned in 1905. The new direct line reached Khartoum in 1899. The final line, to Wau, was completed only in 1961. The system, unlike the others in the study, is isolated from those of other countries and thus there is no rail transit traffic or exchange of cars. Only a short gap once separated the Sudan and the Eritrean systems, but the latter is not now functioning. The gauge, 1.067 m., is the same as that of southern Africa but not of Kenya and Uganda. The railway is a statutory corporation, wholly owned by the government.[1]

The Physical Plant

The physical plant, once one of the best in Tropical Africa, has deteriorated substantially over the last two decades. There are

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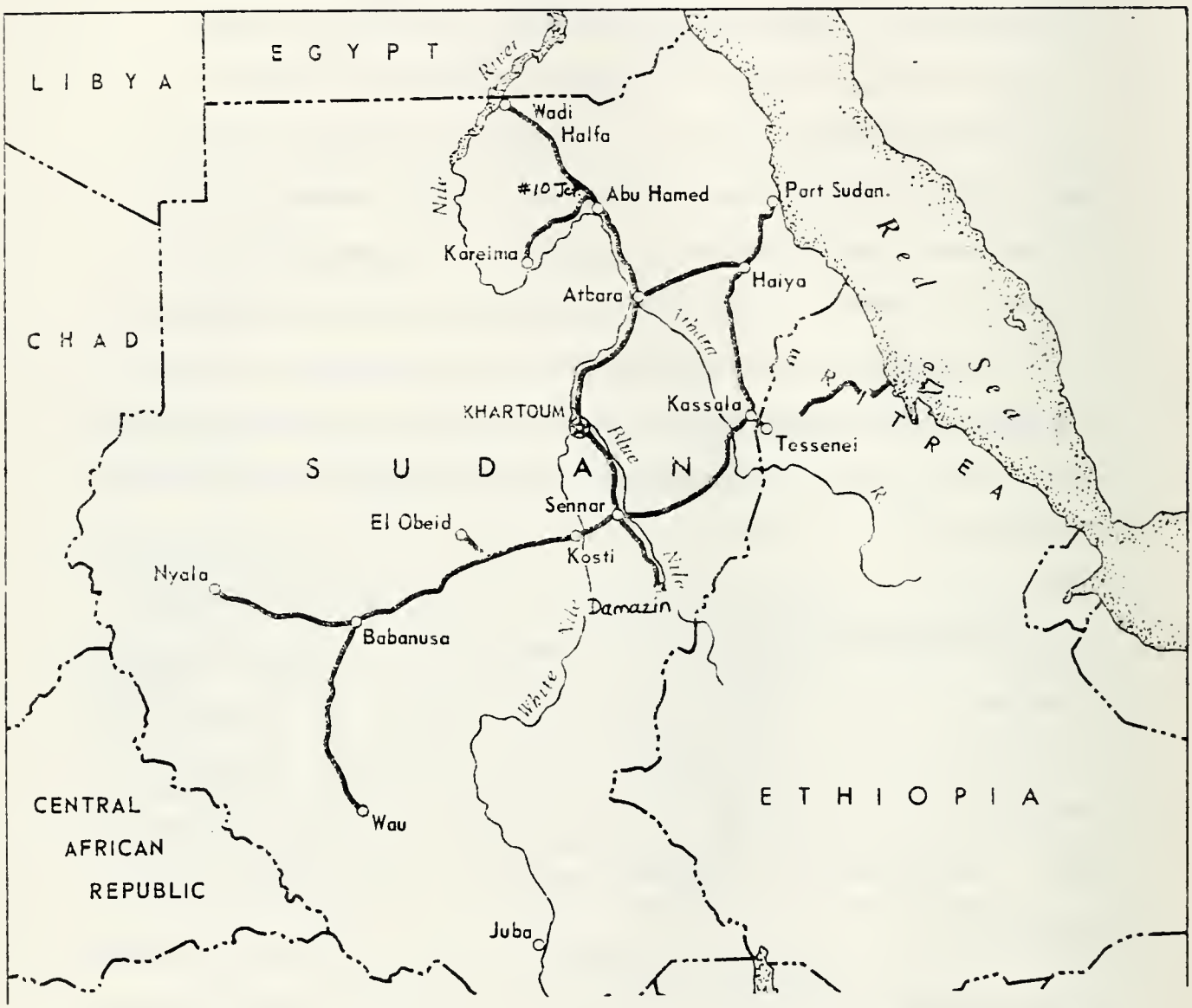
[1]Excellent current data on transport in Sudan are provided by the annual Transport Statistical Bulletin, issued by the Sudan Ministry of Finance and Economic Planning.

Fig. 7 Sudan Railway Lines



inherent problems of flash floods, lack of water in many areas, desert sand, and very long distances with little or no population,[1] but as noted below there have been other problems as well.

Rail. Table 10 indicates rail weight. The main line from Port Sudan via Atbara to Khartoum has 90 lb. rail, which is being extended to Sennar. This is an adequate weight. The secondary main lines--Khartoum to El Obeid, Haifa to Sennar, and Atbara to #10 Junction have 75 lb. rail; the remainder, 50. Most of the rail on the western lines is 50 lb. relay rail taken from the main line as it was upgraded. Much of the light rail dates back to 1910 and some to the turn of the century. Some of the rail is worn, but it is not on the whole in bad shape, though the 50 lb. rail is too light for many of the diesels.

Most sleepers are creosoted wood, unlike the countries to the south that use steel or concrete. Some sleepers are produced in the country, but many are imported, especially from Malaysia; all must go to Atbara for creosoting. The life is estimated from 15 to 25 years. Many of the existing sleepers are termite eaten, and the telephone poles are particularly vulnerable to termites. No serious consideration has been given to other than wood sleepers.

The ballast is poor; some is rock, but a substantial amount is dirt. The ballast has been neglected over recent years, and the poor condition results in slow orders, derailments, and rail wear. A five mile segment on the Haifa Port Sudan main line has been a particular source of derailment. For another example, in the last year in the west, the

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[1] "Stations" on the line through the desert to Wadi Halfa have numbers rather than names.

Table 10

Sudan Railway Lines
1981/1982

	Km	Completion	Track Wt. lb/meter	Train Av. Speed Freight km/hr.	Freight Train Frequency Per Day	Percent Utilization Practical Capacity	000 net tons per year
Port Sudan-Haiya	203	1906	90	25	7.0	41	1733
Haiya-Atbara	271	1906	90	30	5.8	30	1467
Atbara-Khartoum	313	1899	90	31	5.8	44	1477
Khartoum-Sennar	270	1909	75[1]	28	3.4	30	715
Sennar-El Obeid	354	1912	75	28	3.4	19	715
El Obeid-Babanousa	354	1959	50[2]	26	2.3	21	301
Babanousa-Wau	445	1961	50	15	1.0	17	62
Babanousa-Nyala	335	1960	50	28	2.6	17	193
Haiya-Kassala	347	1924	75	39	1.1	12	266
Kassala-Sennar	455	1929	75	35	1.7	21	234
Sennar-Damazin	227	1954	50	25	1.1	18	84
Atbara-#10 Jct.	270	1898	50	30	.9	13	147
#10 Jct.-Karima	222	n.a.	50	19	.9	18	90
#10 Jct.-Wadi Halfa	341	1898	50	30	.4	12	58

[1]To be replaced by 90 lb. rail.

[2]To be replaced by 75 lb. rail from the Khartoum-Sennar line.

number of derailments per month between el Rahad and Babanousa was 9, Babanousa-Wau, 2, Babanousa-Nyala, 2.

Control. Traffic control is based on the same token system as in Tanzania and with results that are even worse because of the very poor communications systems, depending on wires that frequently are not functioning.

Locomotives. As of 1982 there were reported to be 254 line engines and 86 switchers. But of the 254, 96 are steam, and these are now used only for switching. Only 140 of the 254 line locomotives are actually operable, or 55%, and 66% of the switchers. The system has a great variety of diesels from various countries--an added source of maintenance difficulty.

The freight car (freight wagon) fleet is the most extensive in tropical Africa north of Zimbabwe, a total of 6,264, the majority of which will handle 30 to 40 tons. The reported number of passenger coaches was 1,177, but the number potentially available for passenger service was 531 and a large number of these were not usable. About half of the total were third class cars.

Operations. Table 10 provides information on frequency of freight train service, which ranges from 3 each way daily on the main line to 1 each way about each third day on the line to Wau. Passenger service varies from twice a day Khartoum-Atbara to 6 days a week Khartoum-El Obeid, on alternate days on most other lines, down to once a week to Wau. Passenger trains average about 32 km/hr, freight, 27. The scheduled times are much faster. Sudan Railways must have the world record for late trains; for 1982 98.4% of all passenger trains and 98.8%

of all freight trains arrived late. This record has been consistent now for 10 years. Furthermore, the degree of lateness is often substantial; on the long runs it is not unusual for a train to be 12 hours late. The freight car turnaround time averages 21.9 days; the figure has improved slightly since 1978, but compares very unfavorably with a figure of 9 to 10 days from 1964 to 1970. The average load per car (1981) was 25, net load per train, 475. This figure has changed very little in a decade. The average length of haul (1982) was 930 km; this also has changed little.

In 1982 there were about 35,000 employees, of which 7,000 were engineers, accountants and other professionals. The number has not changed much since 1976, but is considerably higher than in years prior to 1976.

The Traffic by Line

Table 10 also provided data of freight traffic by major line segment. These are tonnage figures rather than ton kilometers, but to the extent that the traffic travels over the entire segment, the figures are the same as ones of tkm per km. The heaviest line is from Port Sudan to Haiya, which carries the traffic of both the main line and the Kassala line, with 1.7 million tons. This is relatively heavy, but less so than the heaviest lines in Africa and much lighter than major lines in the U.S. The line to El Obeid with 715,000 is a moderately heavy line (comparable to the Tanzania Central line). The lines to Wadi Halfa and to Wau, with roughly 50,000 are the very light traffic routes. These have both improved, however, since 1978. The figures by

year fluctuate substantially with crop harvests. Only the Karima line shows a significant drop in recent years.

The Traffic Flows

Since virtually all imports come in through Port Sudan; the route inbound from the port carries substantial volumes of machinery and other manufactured goods, fertilizer, sugar, wheat, and petroleum products (only diesel fuel moves by the pipeline). Much of this goes to Khartoum, but a substantial amount moves outward on the other lines as well, plus goods produced in Khartoum, including many food products. The heavy flows toward Khartoum and to Port Sudan are the basic agricultural products: ground nuts, dura, sesame, cotton, hides and skins, and gum arabic. In 1982, the export traffic was 304,000 tons, import traffic, 997,000, local 270,000, livestock, 6,000. The 1978 figures (in 000s) were 509, 1218, 385, and 27, respectively.

Table 11 shows the relative importance of various major categories of traffic, in terms of tons, for 1982 and for the average for the five years ending in 1982. Thus petroleum products constitute the largest single category, yielding from 25 to 29% of the total tonnage, despite the pipeline from Port Sudan to Khartoum. Agricultural products, in total, exceed petroleum, varying from year to year with crop yields. Of this category, rice, wheat, and flour, partly domestic, partly imported, constitute the largest single item, followed by ground nuts and sugar. The miscellaneous category, made up primarily of manufactured goods of all types, yields one-fifth to one-sixth. Fertilizer and cement are other major categories. If 1982 is compared with the

Table 11

Sudan Railways
Traffic by Major Commodity, 1982, 1978/82

Category	1982 tons (000s)	1982 % of total	Average 1978/82 tons (000s)	Average 1978/82 % of total
Petroleum products	473	29	490	25
Agricultural products:				
Rice, wheat, flour	163	10	217	11
Ground nuts	122	8	130	7
Sugar	103	6	150	8
Cotton, cottonseed	50	3	95	5
Sesame	47	3	50	3
Maize, millet	18	1	84	4
Other	22	1	61	3
Total	525	32	787	41
Fertilizer	72	4	83	4
Cement	106	7	108	6
Miscellaneous	410	26	416	22
Railroad traffic	40	2	42	2
Total	1626	100	1929	100

five-year average, agricultural products have fallen somewhat, particularly cotton, while, petroleum, cement, fertilizer, and miscellaneous have remained relatively constant.

Transfer Traffic

Table 12 shows the behavior of traffic since 1975. Passenger traffic (passenger kilometers) was 18% less in 1982 than in 1975--but the figure for 1981 was higher than in 1975; there is no obvious continuing trend. The volume of freight traffic is down 30% over a decade (though this is not a smooth trend; 1982, for example, was higher than 1979). But there has definitely been a continuing loss in traffic over the decade.

Table 12

Changes in Freight and Passenger Traffic Volumes 1975-1982
(millions)

	Passenger P/km	Freight T/km
1975	1,101	2,175
1976	1,166	2,620
1977	1,294	2,415
1978	1,192	1,555
1979	1,057	1,456
1980	1,061	1,966
1981	1,170	1,594
1982	900	1,512

Source: Sudan, Transport Statistical Bulletin, 1981/82.

Rates

The freight rate structure is still based on value of service as well as loading characteristics, but with relatively low rates on commodities which are regarded as consumer sensitive, such as basic foods and petroleum products.

Typical rates, as of September 1982, are shown in Table 13.

Table 13

Typical Rates, Sudan Railways, 1982

	Rate Per Ton	Rate Per Ton Kilometer
Groundnuts	24.50	3.1
Cotton	30.60	3.9
Cement (local)	24.50	3.1
Hides and skins	56.70	7.2
Sugar	24.50	3.1
Gum arabic	24.50	3.1
Fertilizer	24.50	3.1
Textiles	48.90	6.2
Machinery	56.70	7.2
Electrical goods	50.10	6.4
Diesel fuel	23.75	3.0

The rates taper with distance; for example, on diesel fuel, the rate per ton km from Port Sudan to Khartoum, as noted above, is 3.0 pt; to Nyala, 2174 km or 3 times the distance, 1.7.

The overall cost per ton kilometer is 3.8 pt--using the railroad's allocation of cost between freight and passenger service.[1]

The average passenger fares (1982) are--first class, 3.1 pt per km; second, 2.4; third, 1.0.

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[1]Because of the number of exchange rates and overvaluation it is difficult to convert this to U.S. cents in any scientific way. At the 1.28 more or less official rate in 1982, this would be 4.7 U.S. cents per ton mile, at the unofficial rate, 3.5 cents per ton mile.

The Problems and Causes[1]

That the rail system is in acute difficulties is widely recognized. There are two major aspects of the problem, closely interrelated: the loss in rail traffic and the poor service on remaining traffic; and deficits.

The Traffic Loss. As noted above, the system has lost traffic over the last decade, a loss of about 30% from 1975 to 1982. By contract, road traffic has increased sharply; the following table indicates the shift from 1971 to 1980--and there has likely been further shift in the last two years.

Year	Traffic, Ton Kilometers (millions)					Percentage Distribution			
	Rail	Road	River	Pipeline	Total	Rail	Road	River	Pipeline
1971	2683	920	90	--	3693	73	25	2	0
1981	1908	3570	65	275	5818	33	61	1	5

Thus in a decade the rail share has fallen from three-fourths to one-third, and road has increased from one-fourth to over 60 percent.

There are several reasons:

1. Poor service on the railway and inability to handle all available traffic. There are long delays; service is not reliable, and cars are not available for the traffic. There are, in turn, several causes; it is difficult to attach weights to these.

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[1]This portion of the paper is based primarily on information supplied by the Sudan Department of Finance and Economic Planning; the World Bank; USAID paper, Railway Rehabilitation, February 1982; and the article, Sudan Railways: Terminally Ill?, Sudanow, November 1982, pp. 17-18.

a. Poor communications. As in Tanzania, but apparently to a greater degree, poor communication seriously slows down freight and passenger service. The token system does not function properly because the communications lines between stations do not operate. Other communications are equally bad. Thus trains are delayed for long periods waiting for knowledge that the other trains have cleared the section.

b. Bad track conditions, especially in the west; lack of adequate ballast and defective sleepers result in many slow orders, often to 10 km per hour. Bad track results in frequent derailments, which, coupled with the poor communications, can result in delays of several days. Washouts are frequent in the spring; service in the west becomes particularly unreliable from April on into summer.

c. Inadequate usable locomotives and freight cars. As noted, a substantial percentage of the diesels is not in operating order, as well as at least one-third of the freight cars. Thus while the totals might be adequate if they were functioning, in fact the numbers are seriously inadequate. Even relatively new diesels are not operable. The problem is in large measure one of lack of spare parts and of foreign exchange to acquire them. In the past when the port of Port Sudan was operated by the railway the latter had its own source of foreign exchange; when it lost jurisdiction over the port it lost this source and must rely on the Bank of Sudan. Reportedly the railway does not get high priority. One estimate is that of the 1,716

freight cars out of service, at least 1,200 could function if parts were available.[1]

The equipment problem is aggravated by the antiquated equipment in the workshop in Atbara and some loss of trained personnel to the Gulf states.

d. Shortages of diesel fuel, very severe in the past year in the whole economy. A train may get to the end of its run and not be able to return for lack of fuel.

e. Attitudes of labor. While this is difficult to quantify, reportedly worker productivity is low and morale is poor. Shortages of trained personnel affect not only equipment maintenance but overall operation of the railroad as well.

Poor service not only lessens the attractiveness to the users, but it also aggravates the equipment problem because it results in slow turnaround time.

While it is difficult to document, it is generally agreed in the Sudan that a considerable amount of traffic loss is a result simply of inability of the railroad to move all traffic available to it. But in addition, the poor service has enabled road transport, despite its own fuel and spare parts problems, to gain a large portion of the traffic.

2. The rate structure. The value of service nature of the tariff, as in the U.S. and elsewhere, has enabled road transport to capture a large portion of the high-value manufactured goods traffic while it

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[1] "Sudan Railway," Sudanow, op. cit., p. 18.

cannot compete on the low value goods which have relatively low rail rates.

3. Completion of the paved highway from Port Sudan to Khartoum in 1978. More than any one other event, this sharply increased the ability of road transport to compete, both cost and timewise, on the merchandise and other traffic to Khartoum. It is estimated that over half of the traffic between the port and Khartoum goes by road.

4. Completion of the pipeline from Port Sudan to Khartoum, which diverted substantial traffic from rail. This line handles only diesel fuel (gas oil), and petroleum remains a major revenue source for the railroad.

5. Marketing of rail service. The railroad management reportedly has been slow to move in the direction of actively soliciting traffic.

Total traffic, rail and road, has been restricted by foreign exchange problems, which seriously restrict imports and, for a period, by the decline in agricultural production, particularly of cotton, a trend that now has been reversed.

The Deficits. As shown in Table 14, the operating deficit as reported by the railroad has never been substantial, even in recent years. But real costs are significantly in excess of reported costs because of the deferment of maintenance of track and equipment. The overall deficit, in 1982, was estimated to be Ls 26 million, which of course has to be made up from government revenues at a time when the government is experiencing serious budget deficits. The deficit is easy to explain:

Table 14

Sudan Railways, Revenue, Cost, and Profits,
1938, 1958, 1969 and 1975-81
Ls millions

Year Ending in	Revenues			Oper. Expenses	Oper. Profit	Oper. Ratio
	Freight	Passenger	Total			
1938						.50
1958						.73
1969			17.1	16.6	.5	.97
1975	19.6	5.4	25.0	27.0	-2.0	1.08
1976	27.2	5.9	33.1	29.8	3.3	.90
1977	25.9	7.7	33.6	31.6	2.0	.94
1978	24.0	9.0	33.0	32.7	.3	.99
1979	30.1	8.7	39.0	45.8	-6.8	1.18
1980	42.7	10.1	52.9	55.3	-2.4	1.05
1981	46.5	9.6	56.1	63.9	-7.8	1.13
1982	55.0	11.0	66.0	69.7	-3.7	1.06

Source: Sudan, Transport Statistical Bulletin, 1981/82.

1. The traffic loss, as noted; it is virtually impossible for a railroad to reduce costs in proportion to a decline in traffic, and thus cost per ton/km rises.

2. The use of artificially low rates on a number of basic commodities, held low by the government for political and development reasons. The railroad is not free to set its own rates.

3. Delays by government agencies in paying amounts owed the railroad.

4. Low labor productivity, which raises labor costs. There are varying explanations: the inefficient machinery and lack of spare parts, for example. Others attribute the problem to a strong labor union and craft union rules that restrict the work individuals can do.

But workers claim that wages are unreasonably low, that living conditions at many points are very bad; that water is often not available for track workers.

5. In the past few years, sharp increases in fuel costs and in wages, not compensated for by equivalent increases in revenue.

Importance of the Railroad

Despite the traffic loss the railroad continues to play a major role in the economy of the country, particularly in the areas away from Khartoum. The road network is still very limited in much of the country. The AID Report, Railway Rehabilitation, PL 480 Title III, February 1982, provides some excellent examples of the importance of the railway to economic activity in Kordofan and Darfur, for exports of farm products and imports to the area, both of which depend primarily on rail. Examples quoted from the Report, with regard to towns in North Kordovan include:

> Umm Rawabah: "All of the (groundnut) factories... rely almost exclusively on the railway for shipping their product to Khartoum and Port Sudan" (p. 6).
>
> "The cotton stored at Semeih is transported to Khartoum and Port Sudan by rail" (p. 7).
>
> Al Rahad: "Al Rahad depends almost exclusively on the railway for shipping products out and bringing products in" (p. 8).
>
> Nyala: "All of the city's staples, most notably sugar and flour, are brought in by rail from Khartoum and Port Sudan...According to merchants in the area, products brought into Nyala by rail are vital to the operation of the economy" (p. 10).
>
> "It was apparent throughout this trip that it is the railroad which serves as the focal point for village and town activity from Kosti westward" (p. 11).

The government and international agencies have likewise stressed the importance of improvements to the railway, for example in the 1982/83 public investment program, "...the railways, which provide the most cost effective means of moving large tonnages over long distances...."[1] While good comparative cost data are not available, there is widespread belief that rail costs are lower than road transport costs.

The Future

Substantial amounts have been allocated for the railways in the development budget in recent years. In the 1980 and 1981 years, however, only a small portion--about 10 percent--was actually used. In 1982, Ls 78 million had been allocated; 1972, Ls 72 million used. In the five-year period 1977/81, 17 percent had been utilized, primarily for freight cars and locomotives. The 1982/83 budget provides Ls 78.6 million, of which Ls 63.3 million is foreign, provided by various donors and lenders. The two major items are for track repair, Ls 28 million and freight cars, Ls 26 million. Over two decades there have been four World Bank railway loans[2] and a fifth project is now being negotiated, primarily for spare parts. US AID has been providing assistance for communications from Babanousa to Wau, drilling of wells along the line, and replacement of wooden sleepers on a 160 km stretch on the line to Nyala.

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[1] Ministry of Finance and Economic Planning, Three Year Public Investment Program, 1982/83-1984/85 (Khartoum, 1982), p. 19.

[2] The earlier ones were: 1958, $39 million (IBRD); 1965, $31 million (IBRD); 1974, $24 million (IDA).

But despite these development funds and external assistance, the system has continued to deteriorate and traffic to fall. Two theories can be advanced about future trends. One is that the improvements to date have involved too much patchwork and not enough basic improvement of track and equipment, and inadequate establishment of priorities. Complete rebuilding of the system would be very expensive, however, requiring substantial foreign funds that are not likely to be available. But some properly designed physical improvements, particularly in communications, spare parts, and diesel and freight car maintenance, may enable reasonably efficient operation with not too much additional capital. This is based on the view that the capital funds in the past have not been allocated on an optimal basis.

The other theory is that the troubles lay primarily with management and labor. There seems to be little question about the competency of top management; the problem appears at the middle management levels, and with labor union policies and attitudes. Some technical assistance in management, according to this approach, could be of great assistance, but reportedly top management regards this as unnecessary. Improved labor attitudes are even more difficult to implement, although more effective techniques of labor relations by management could assist.

In summary: As of 1983, Sudan Railways continues to play a major role in the economy, particularly in those areas in which the road network is very limited. Some of the Khartoum-Port Sudan traffic probably can be recovered from road transport by changes in the rate structure. Hopefully the efficiency of the system can be turned around, but some technical assistance from abroad at management levels appears to be

essential; mere changes in "hardware" alone may not solve the problems. On the other side of the picture, more reasonable charges for diesel fuel for highway use (they are among the lowest in Africa) and more effective action to prevent overloading on the Port Sudan highway should assist in obtaining a more optimal balance of traffic between rail and road.

PART IV

SUMMARY

Table 15 summarizes basic data for the five systems, although information on all categories is not available for all lines. The Sudan system is the largest in terms of mileage, but the Zimbabwe system in ton kilometers, with three times the ton/km of the Sudan railways. Thus it has by far the highest traffic density--1,800,000 ton/km per km. It likewise has by far the highest number of ton/km per employee, 8 times as much as the Tanzania and Sudan systems, and about one-fourth as great as in the United States, despite the lower traffic density compared to the U.S. Sudan Railways has by far the greatest number of employees and the greatest number per kilometer. Some of the advantages of Zimbabwe Railways are a product of the heavier traffic density, but some obviously reflect a difference in the training of employees and the overall efficiency of operation. Data are not sufficient to allow separation of the relative influence of these various items.

In general, on the basis of studies in other countries, the traffic density on all systems is high enough to allow reasonably low cost operation although not nearly as low as it would be if the lines had the

Table 15

Summary Data, Railways of Four African Countries

Railway	Km of Line	Locomotives	Freight Cars	Freight Tons Carried 000	Freight Net ton/km 000,000	Traffic Density ton/km per km 000	Employees	Employees per Kilometer	Ton km/per Employee	Rail Percentage of Total Freight Traffic	Operating Profit 000,000	Operating Ratio	Overall Earnings or Deficit 000,000
National Rys of Zimbabwe (1982)	3,400	362	13,000	11,000	6,610	1,808	20,000	5.9	330,500		Z $20.3	89	US $-15.0
Zambia Railways (1976, 1981)	1,100	89	2,980	2,600	920	836	7,800	7.1	117,948		-K 1.9		
Tazara (1978)	1,885	100	2,200	1,000	900	477	10,000	5.3	90,000		n.a.		
Tanzania Railways (1979)	2,800	116[1]	3,800	850	650	232	16,000	5.7	40,625	43	+Ts 2.3[3]	82	US $- 3.0
Sudan Railways (1982)	4,756	250[2]	6,204	1,630	1,908	401	35,300	7.4	46,176	33	Ls - 3.7[3]	106	US $-18.0
Total	13,950												

[1] Plus 63 steam, not used in line service.

[2] Plus 96 steam, used for switching only.

[3] After depreciation.

Sources: Zimbabwe, Monthly Digest of Statistics, August 1982; Sudan, Transport Statistical Bulletin, 1982; Tanzania, Canadian International Development Agency, Transport Sector Study; Zambia and Tazara, primarily from CIDA (Tanzania) Transport Study; Bank of Zambia, Annual Report, 1981.

traffic density of the major routes in the U.S. But none of the systems have density as low as the lowest traffic lines in the U.S. though a few individual branches in some countries do.

The earnings pictures do not differ as much as might be expected. The Zimbabwe and Tanzania lines show an operating profit after depreciation; the Sudan and Zambia lines a small deficit. In no case are the railroads a serious drain on government tax revenues. But when interest costs are considered as well, none of the systems show a profit. Zimbabwe Railways show the largest deficit, equivalent to about $45 million US dollars, and the Sudan system about US $18 million. The Tanzania figure is roughly $3 million (any attempt at conversion to a common denominator suffers from the non-free-market-exchange-rates problem). But the governments, while preferring to avoid these deficits, typically regard them as inevitable if the railroads are to make maximum contribution to economic development.

A major feature in all of the countries except Zimbabwe is the inability to handle all traffic available; the CIDA estimate in Tanzania is that the railroad can handle only about half of the traffic that would be available to it. There are frequent references to this problem in the Sudan and Zambia has, for example, asked that maize coming up from the south be shipped by road rather than rail because of lack of rail capacity.

There are several reasons, much the same in the various countries: especially in Tanzania and the Sudan, poor track conditions, mainly ballast and poor communications for control of trains; inadequate equipment maintenance, arising from lack of spare parts and trained personnel;

and general shortages of management and technical personnel in all four countries. The relatively poor service arising from these same sources causes further loss in traffic and poorer utilization of equipment.

Especially in Sudan on the major Port Sudan-Khartoum route, and to some extent in Zimbabwe, traffic in manufactured goods has been lost because of the value of service nature of the tariffs. Only Tanzania has shifted from such a tariff to one based on cost of handling.

While it is difficult to come up with adequate comparative data, there is strong evidence in all four countries that rail costs are lower than road transport costs except on short distances--under 100 to 200 km. The most careful study available, by CIDA in Tanzania, shows that road transport costs are three to seven times rail costs. Rail transport likewise places substantially less drain on foreign exchange, per ton/km of traffic.

Passenger service remains of some importance; volumes have fallen primarily because of inadequate capacity. Third class fares are very low by any standards--but cars are crowded and standards have fallen, except on the main line passenger trains in Zimbabwe.

Steam locomotives have been phased out except for some switching service in Tanzania and the Sudan; only Zimbabwe has rebuilt and retained in service a number of coal burning locomotives for main line service. The heaviest traffic line in that country, one of the heaviest in Africa, is being electrified. Rail, most of which is light by U.S. standards, ranging from 45 lb. per yard to over 100, is gradually being upgraded, 56 to 80 on main lines in Tanzania, 75 to 90 in the Sudan.

The governments, without exception, place strong emphasis on the importance of improved rail service, and considerable World Bank and foreign donor aid have been obtained to improve the systems. The future of rail transport in Africa depends in large measure on the ability of the rail systems to improve efficiency and increase their carrying capacity and to revise their tariffs to avoid loss of high value merchandise traffic. The governments, in addition to providing financial assistance, can aid in attaining an optimal balance between rail and road transport by adequate user charges on road transport, prevention of overloading, and concentrating road construction over the next decade on feeder roads rather than on ones paralleling rail lines.

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